1. Research activity (max 1.000 words)

The aim of my research is contributing to the preventive conservation of paper collections through the development of innovative methods for the forecasting and the assessment of microclimate in library and archival depositories.

Library collections are frequently affected by deterioration processes due to the environment in which they are stored (e.g. mechanical stress, acidification of paper and biological attacks). Indoor environments housing paper collections are characterised by the effect of stabilisation on relative humidity provided by the collections themselves, which act as moisture buffering agents [1]. In the study of microclimate for preventive conservation, this effect is particularly interesting as relative humidity plays a key role in mechanical, chemical and biological deterioration mechanisms. Microclimate monitoring designed for long-term periods can be combined with dynamic simulation to provide a complete characterisation of the indoor climate, thus allowing to investigate more deeply the interactions between the building and the outdoor climate as well as between the objects and their surrounding environment.

The investigation will attempt to implement a model to simulate hygrothermal conditions in a library storage, where the impact of hygroscopic materials is greater and should not be neglected. In order to achieve this goal, the HMWall (Heat and Moisture transfer) model coupled with the whole-building dynamic simulation software IDA Indoor Climate and Energy will be investigated and implemented. The HMWall model, based on Künzel equations, includes also the transport mechanism of the moisture component through the walls and, when coupled with IDA ICE software, can provide a reliable tool for diagnosis and prognosis

of conservation issues. This model has been recently the object of a thorough analysis and revision of its hygrometric part [2] and it has been already used to model the hygrothermal behaviour inside historical buildings. The simulation model will be calibrated through the values measured in a suitable case study.

Dynamic simulation can also be exploited as a useful tool to evaluate the impact of retrofitting solutions and environmental control strategies in terms of deterioration risks for the artworks [3]. In fact, damage functions provide the effect produced in the objects due to the thermo-hygrometric conditions they experienced. Non-Destructive Testing (NDT) techniques such as spectroscopy and imaging [4,5] allow performing measurements directly on the artifacts, relating changes in the material properties to ongoing or ceased deterioration processes. These advanced non-invasive techniques will be explored to compare experimental measurements of moisture content with the environmental observations.

References

[1] Kupczak, A. et al., Energy and Buildings 158 (2018): 77-85.

[2] Frasca, F. et al., IOP Conf. Ser.: Mater. Sci. Eng., 364(2018): 012024.

[3] Leissner et al. Heritage Science, 3.1 (2015), 3-38.

[4] Banerjee, D. et al., Optics Express 16.12 (2008), 9060-9066.

[5] Corsaro, C. et al., Phys. Chem. Chem. Phys., 18.48 (2016): 33335-33343.

2. Research products

a) Publications (ISI journals)

García-Diego, F.-J.; **Verticchio, E.**; Beltrán, P.; Siani, AM., “Assessment of the Minimum Sampling Frequency to Avoid Measurement Redundancy in Microclimate Field Surveys in Museum Buildings.”, Sensors (2016), 16, 129.

b) Abstracts

Verticchio, E.; Siani, A.M.; García-Diego, F.-J.; “Studio di cornici microclimatiche e ottimizzazione della frequenza di campionamento delle osservazioni termoigrometriche. Caso di studio: due ritratti di J. Sorolla nel Museo Pio V di València (Spagna)”, Poster contribution in SCIENTIA AD ARTEM (III ed.), Florence, 8th June 2017.